Soil Moisture Modeling in URGWOM

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February 3, 2015

Acknowledgements

- Collaborative effort involving the following:
  - Greg Sullivan, Spronk Water Engineers
  - Nabil Shafike, New Mexico Interstate Stream Commission
  - Marc Sidlow and Amy Louise, USACE Albuquerque
  - Hydros and CADSWES

Need for Soil Moisture Modeling

- Hydros has developed a daily-timestep model of the Lower Rio Grande below/including Elephant Butte Reservoir
  - Will be incorporated into main URGWOM model
- Daily CIR does not line up with daily, historical diversions
  - Part due to lag times (will never line up perfectly)
  - Part due to CIR estimate (will never be actual CIR on that day)
  - Part due to the fact that diversions/orders are not intended to meet CIR on individual days
- In the real-world, diversion/orders tend to follow “stepped” pattern, not daily fluctuations

Need for Soil Moisture Modeling

- Water is put on the field and either used by crops, surface water runoff, or enters soil moisture column (and either replenishes root zone or goes to deep percolation)
- Crops draw on water from soil moisture column until next surface water application
- RiverWare historical model:
  - Daily differences between historical diversions and CIR result in constant shortages and excess flows
  - Results in excessive GW pumping and waste channel flows

Need for Soil Moisture Modeling

- RiverWare Operations Model:
  - Require iterative routine to determine exact release required to meet demands (difficult in complicated systems with return flows and SW/GW interaction)
  - Daily shortage/excess; results in excessive GW pumping and waste channel flows
- Furthermore, “soil moisture building”
  - Water applied to fields early in the season when there is little or no CIR

Solution…

- In times of excess surface water diversions (greater than daily CIR), excess replenishes soil moisture
- In times of shortage, demand is met from soil moisture

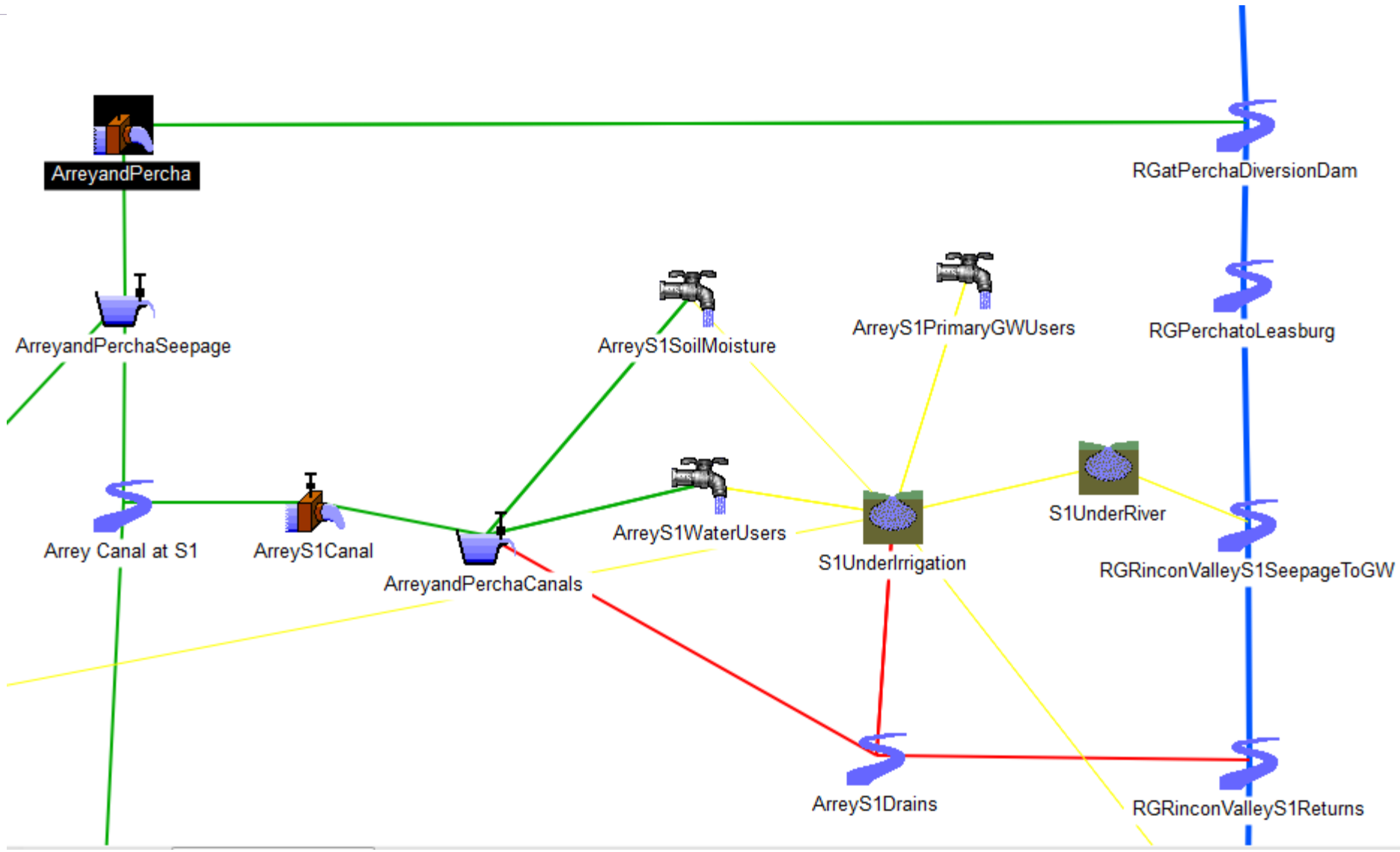
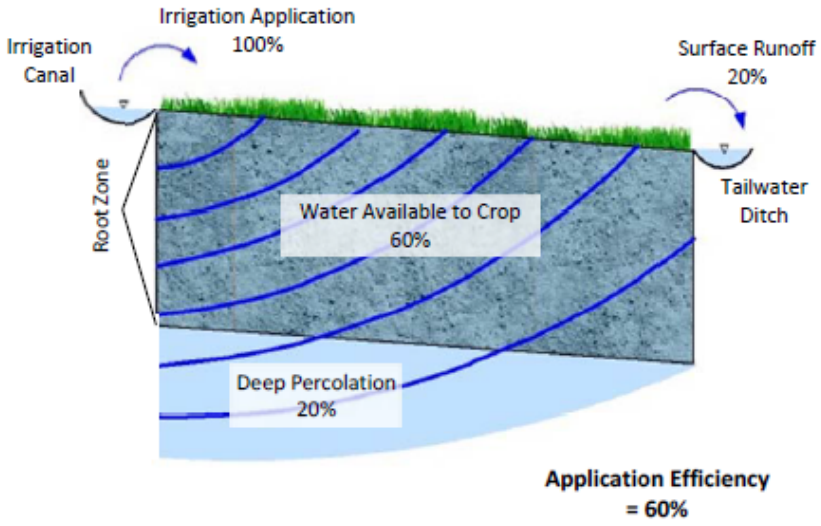
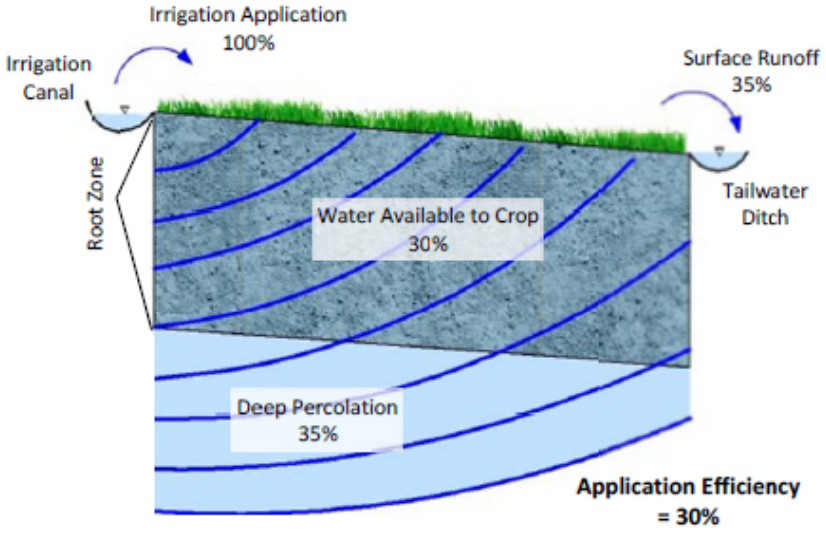

ArreyandPercha
RGatPerchaDiversionDam
ArreyandPerchaSeepage
ArreyS1SoilMoisture
ArreyS1PrimaryGWUsers
RGPerchatoLeasburg
Arrey Canal at S1
ArreyS1Canal
ArreyandPerchaCanals
ArreyS1WaterUsers
S1UnderIrrigation
S1UnderRiver
RGRinconValleyS1SeepageToGW
ArreyS1Drains
RGRinconValleyS1Returns

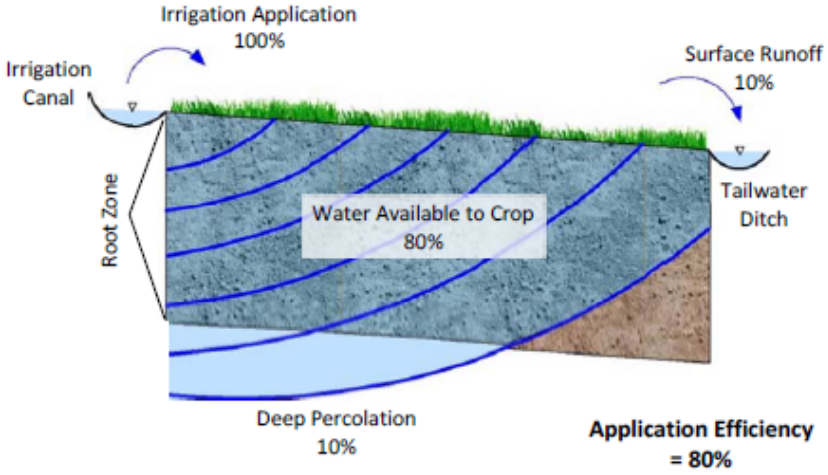
Figure 1
Irrigation Application Efficiency
Illustrative Examples

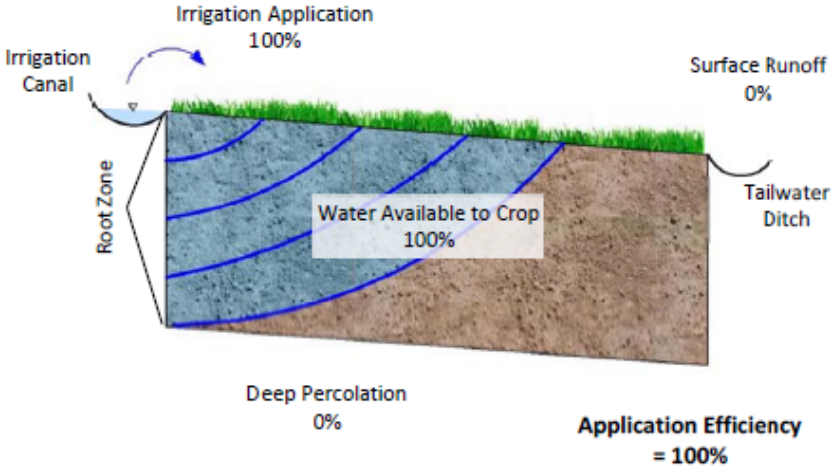
Full Supply Examples





Deficit Supply Examples



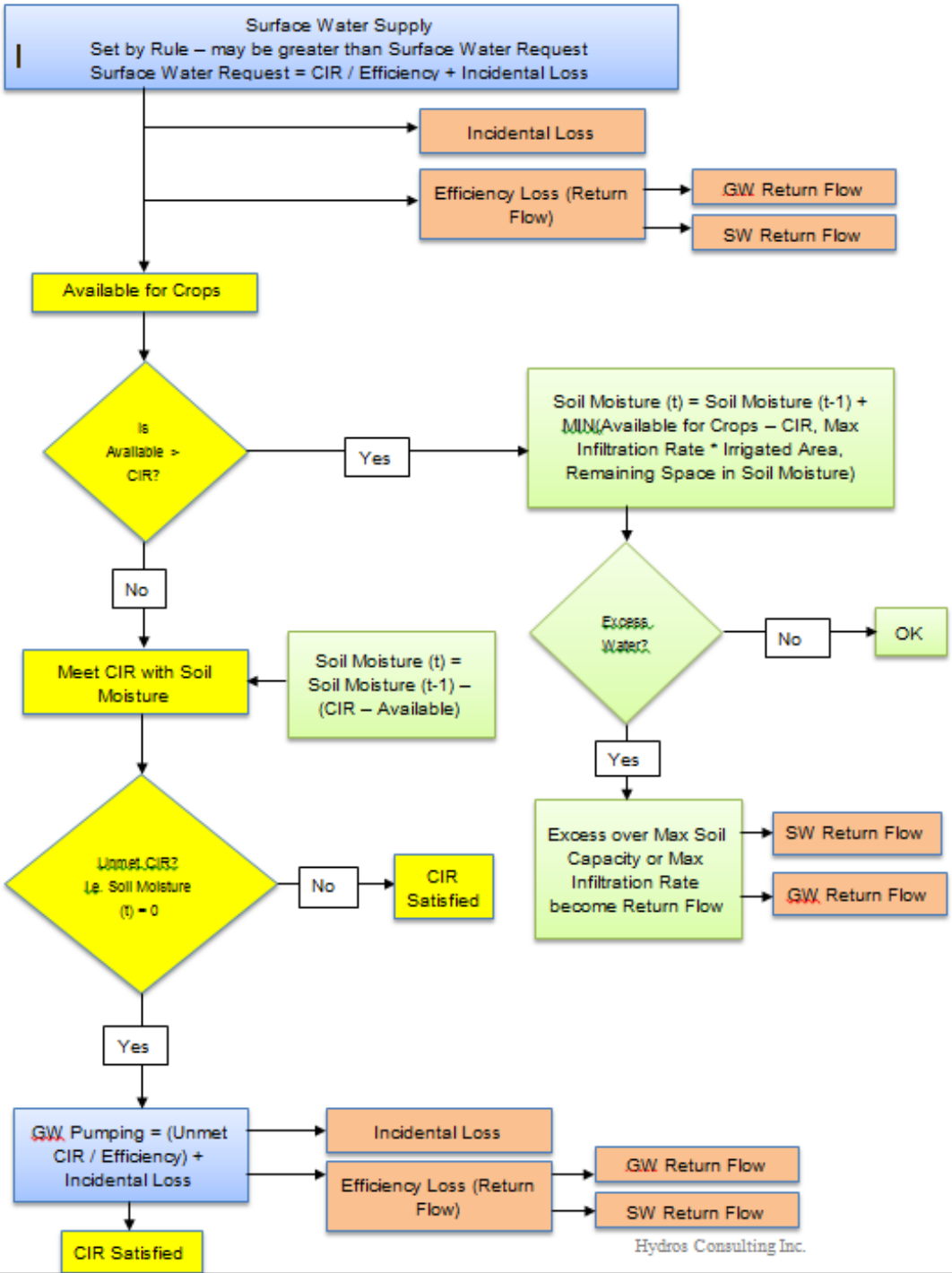


Simplification

- Ignore variable application efficiency for now
- Assume constant on-farm efficiency (can vary with time, but not state of soil moisture column)
- New method for water user objects (root zone), groundwater object should represent the alluvial aquifer (SW/GW ineteraction)

Development Process

- Greg Sullivan at Spronk Water Engineers developed the idea; resulted in a farm budget algorithm
- Hydros worked with NMISC and USACE to work out the model requirements specific to URGWOM
- Hydros developed an algorithm tailored to RiverWare based on Greg's algorithm and URGWOM needs
- CADSWES developed

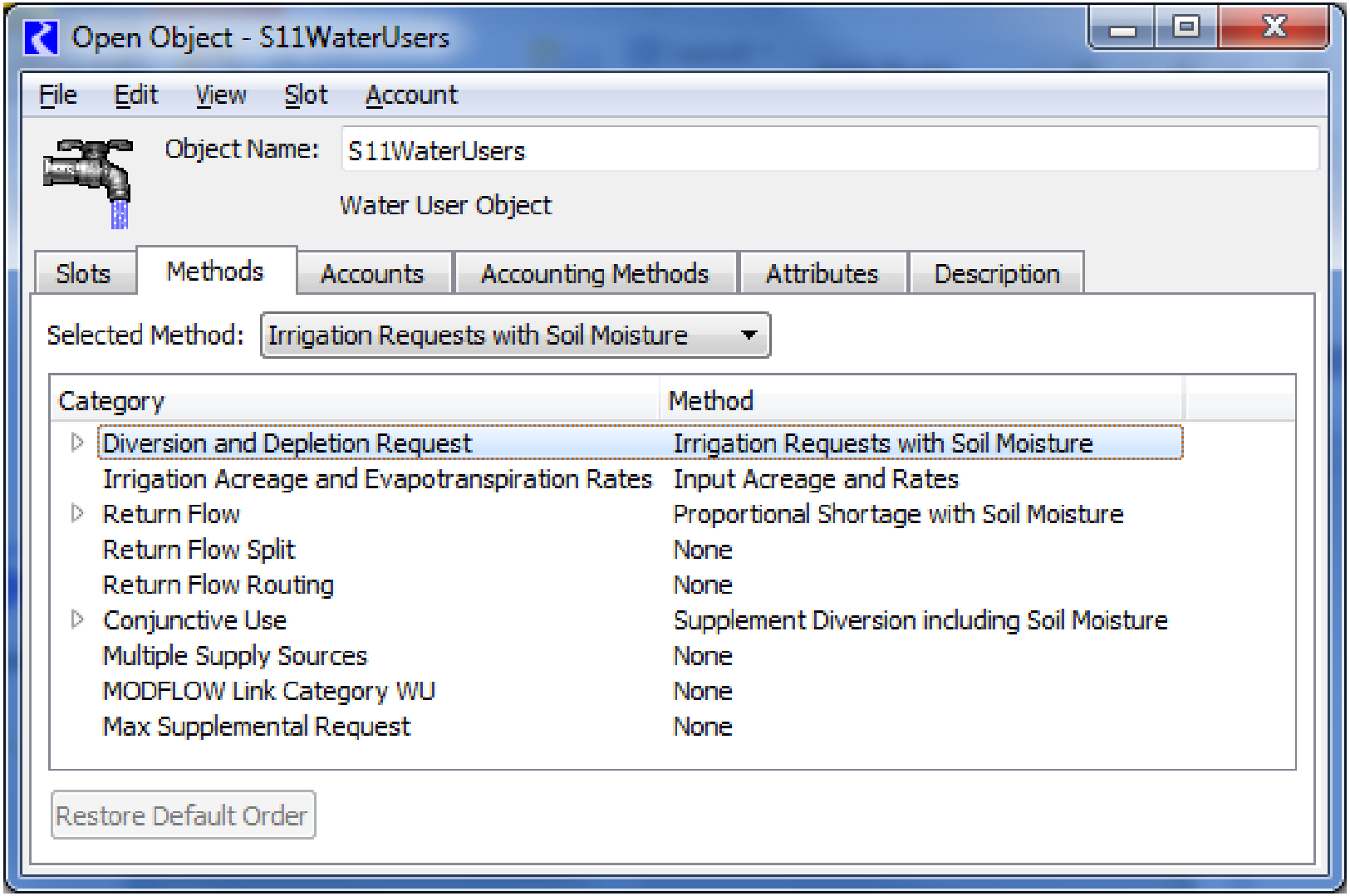

Surface Water Supply
Set by Rule – may be greater than Surface Water Request
Surface Water Request = CIR / Efficiency + Incidental Loss
Incidental Loss
Efficiency Loss (Return Flow)
GW Return Flow
SW Return Flow
Available for Crops
Is Available > CIR?
Yes
Soil Moisture (t) = Soil Moisture (t-1) + MIN(Available for Crops – CIR, Max Infiltration Rate * Irrigated Area, Remaining Space in Soil Moisture)
No
Excess Water?
No
OK
Yes
Meet CIR with Soil Moisture
Soil Moisture (t) = Soil Moisture (t-1) – (CIR – Available)
Excess over Max Soil Capacity or Max Infiltration Rate become Return Flow
SW Return Flow
GW Return Flow
Unmet CIR? I.e. Soil Moisture (t) = 0
No
CIR Satisfied
Yes
GW Pumping = (Unmet CIR / Efficiency) + Incidental Loss
Incidental Loss
Efficiency Loss (Return Flow)
GW Return Flow
SW Return Flow
CIR Satisfied

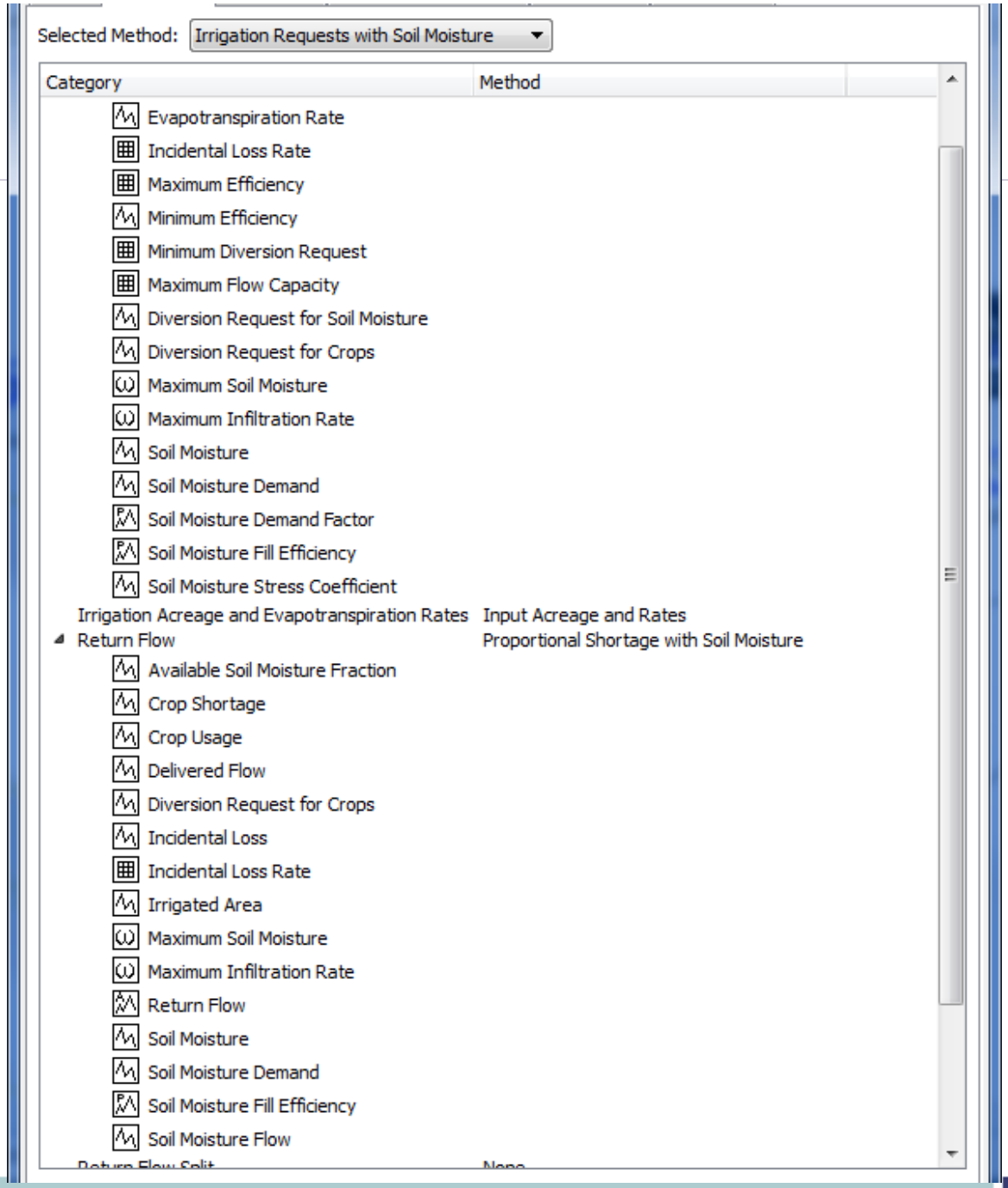
New Methods in RiverWare

- New methods on Water User in RiverWare 6.6

- Model available soil moisture
  - Soil moisture storage goes from zero to maximum capacity where zero means no soil moisture available for crops – wilting point of the crops

New Methods in RiverWare





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Next Step…

- Update URGWOM to include new methods

- Questions?